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(54) Rotary Positive-Displacement Fluid-Machines

(57) A sliding-vane pump, which may be a vacuum pump, has a rotor (5) provided with a vane(s) (9) and rotates about an axis (16) in a housing bore. The or each vane has an extension (15) located on the other side of the axis (16). When the required positive or negative delivery pressure has been attained, the vane(s) (9) is withdrawn from the bore wall (6) by a surface (28) of an element (27) movable transversely of the axis (16) by e.g. a rod (19) connected to a delivery-pressure controlled actuating unit, Fig. 1 (not shown). The pump is thereby rendered inoperative. The centre of gravity of each vane is situated such that it moves to the other side of the axis (16) when the vane is withdrawn from the bore wall.

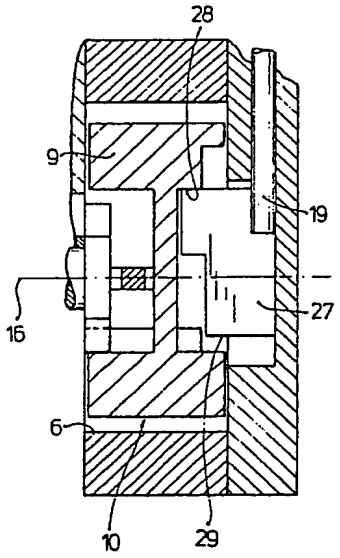

Fig.2

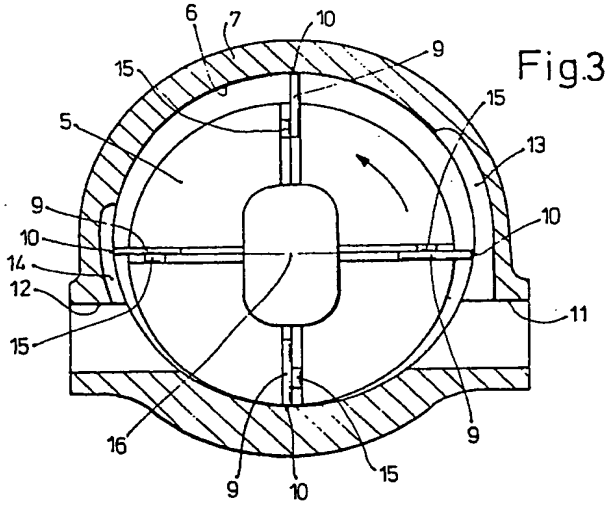

Fig.3

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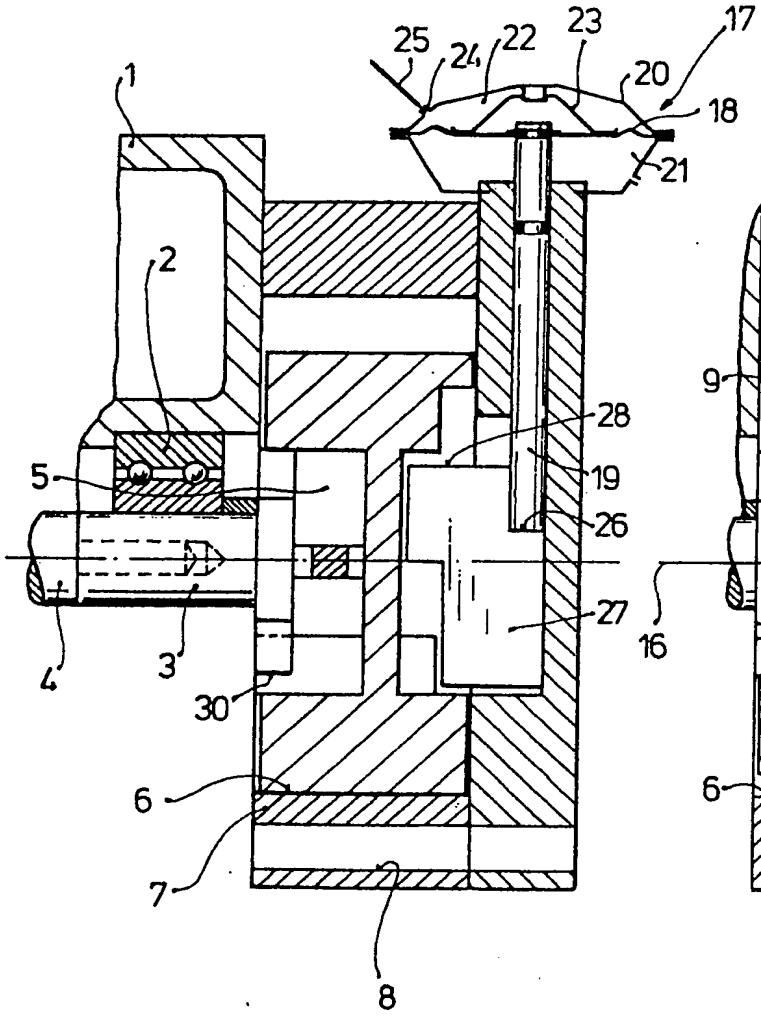

Fig.1

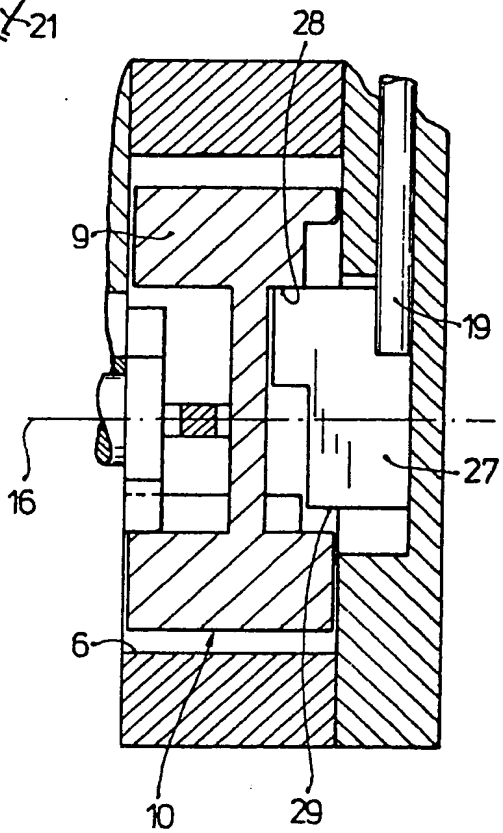

Fig.2

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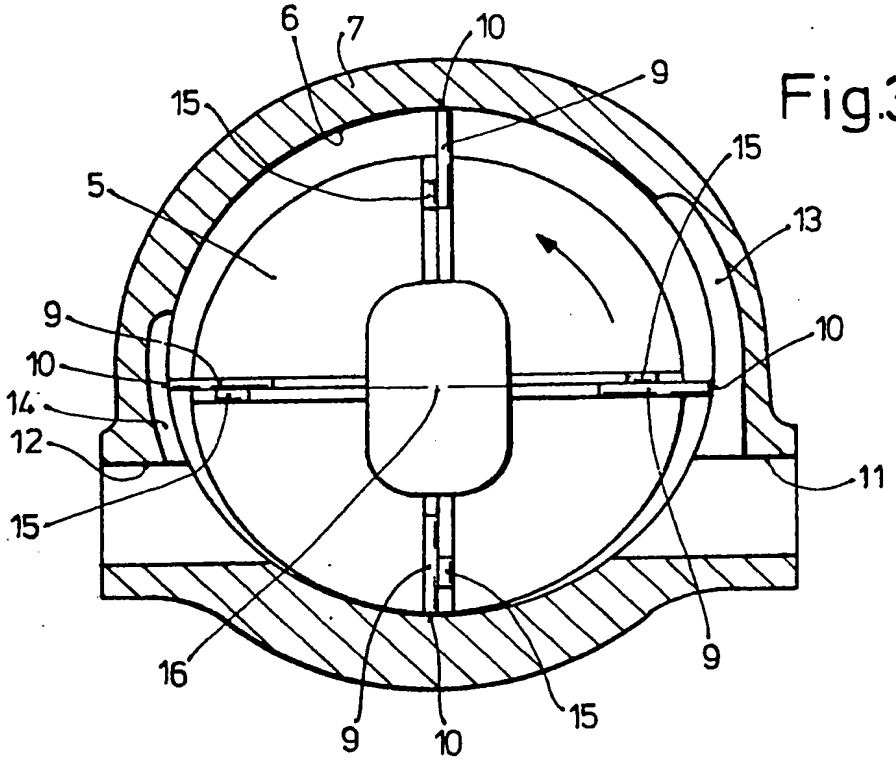

Fig.3

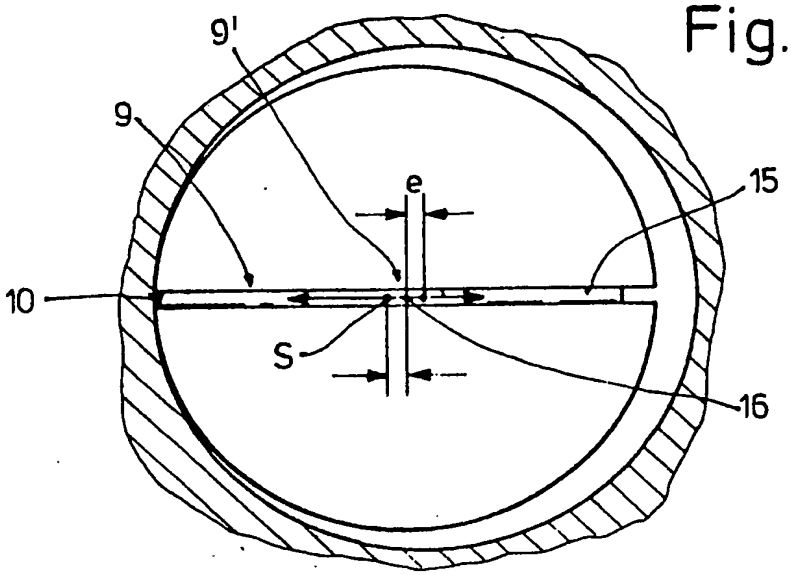

Fig.4

SPECIFICATION
Rotary Displacement Pump

The invention relates to rotary positive displacement pumps.

In the rotary piston pump described in U.S. Patent No. 3,904,321, after a certain delivery pressure has been obtained, a pressure-controlled actuating unit puts out of operation a vane normally biassed into engagement with the rotary piston by retaining the vane in its top dead centre position. This has the disadvantage that the rotary piston strikes against the vane during each revolution, thus causing friction and noise.

Vane-type pumps are generally more compact and more suitable for producing a vacuum. In pumps of this type, it is more difficult to construct a device for retaining the vane, since the vanes rotate.

A rotary positive displacement pump according to the invention has a rotor which rotates eccentrically in a housing, at least one vane slidable in a slot so as to engage a contact surface and so separate an inlet side from an outlet side, and a device for switching over the or each vane to a position in which it remains out of engagement with the contact surface so that the pump is rendered inoperative, the position of the mass centre of the or each vane being transferable by said device from a positive eccentricity at which the or each vane is retained against its contact surface by the forces due to mass acting thereupon, to a negative eccentricity at which the or each vane is held out of engagement with the contact surface by the forces due to mass, and vice-versa.

Thus, the rotary displacement pump of the invention has the advantage that it is of more compact construction and the or each vane is fully retracted by the rotating piston after a certain delivery pressure or vacuum has been attained. All friction is thus avoided. This is particularly advantageous when the pump rotates at high speed. Furthermore, sounds caused by impact, which are particularly troublesome in a motor vehicle, are avoided. By virtue of the said advantages, the pump is preferably usable as a brake servo pump in a motor vehicle in which it can be driven directly by the shaft of the generator. This shaft can attain a rotational speed of 15,000 r.p.m. and a pump having the features in accordance with the invention can cope with this rotational speed since it is switchable and its "on" period is relatively short. Compared with conventional pumps which rotate continuously, the drive of a switchable pump of this type is particularly energy-saving.

The invention is further described, by way of example, with reference to the drawings, in which:

Figure 1 is a sectional elevation of a vane-type pump;

Figure 2 is a similar view showing a vane which has been put out of operation;

Figure 3 is a cross-section showing the arrangement of four vanes; and

Figure 4 is a diagram of the forces acting upon the vane.

A generator of a motor vehicle has a housing 1, and an extension 3 of its generator shaft 4 extends centrally out of the housing 1 and is supported by means of a ball bearing 2. A vane type pump is secured to the shaft extension 3 and its rotor 5 rotates in an eccentric bore 6. The bore 6 is located in a pump housing 7 which is secured to the generator housing 1 by means of bolts which are inserted through fastening bores 8 and are screwed into the housing 1.

As may be seen in Figure 3, the rotor 5 is cross-slotted and receives four vanes 9 whose end faces 10 slide along the interior wall of the bore 6 during rotation of the rotor 5 in the housing 7 with positive eccentricity *e*. The pump housing 7 has an inlet 11 on a suction side and an outlet 12 on a pressure side; the inlet 11 and the outlet 12 are intersected by recesses 13 and 14 in the bore 6.

It may also be seen that each vane 9 has a rear extension 15 located on the other side of an axis 16 of rotation so that diametrically opposite vanes overlap. In this manner, each vane 9 has an eccentric mass 9' whose centre of gravity is at S (see diagram of Figure 4).

Furthermore, a delivery-pressure-dependent device 17 is mounted on the pump housing 7 and has a diaphragm 18 acting as a working member, and an actuating rod 19 secured to the diaphragm 18. The diaphragm 18 is fitted into a diaphragm box 20 where it separates an atmospheric air chamber 21 from a working chamber 22. A return spring 23 is arranged in the working chamber 22. Furthermore, the diaphragm box has a connection piece 24 for a line 25 leading to a load (not further illustrated).

Alternatively, however, a solenoid, switching in dependence upon pressure, can be used as the delivery-pressure-dependent device.

A free end 26 of the actuating rod 19 carries an attachment 27 which has two abutment surfaces 28 and 29 by which it can act upon each vane 9. The attachment 27 is constructed such that it is normally inoperative, that is to say, when the pump is in its delivery position (Figure 1). A further stop 30 is provided on the rotor 5.

Figure 2 shows the delivery-pressure-dependent device 17 in its other end position. When the device 17 is in this end position, each vane is withdrawn by the abutment surface 28 upon passing through the bottom dead centre, so that the end surface 10 of the vane is no longer in contact with the wall of the bore 6. The other abutment surface 29 serves to return each vane into its delivery position.

When the pump is started, the mass centre S of each vane 9 is located at that side of the axis 16 of rotation on which the end face 10 of the vane is also located. The end face 10 is thus pressed firmly against the wall of the bore 6 by centrifugal forces of the eccentric mass 9' of the vane 9, and each vane 9 thereby sealingly closes

its associated chamber. The pump operates to produce a vacuum, and the delivery pressure, i.e. the delivery vacuum, is also effective in the working chamber 22.

Thus, when in the special case of a vacuum pump, the delivery vacuum exceeds the magnitude of the vacuum by a specific value, the return spring 23 is compressed and the actuating rod 19 is pulled upwardly. The abutment surface 28 of the attachment 27 then comes into contact with each vane in the bottom dead centre position and displaces each vane to an extent where its eccentric mass 9' moves to the other side of the axis 16 of rotation. The vane, raised from the wall of the bore 6, terminates delivery by the pump. The vanes 9 are thereby pressed against the stop 30 in the rotor by their mass 9' and the centrifugal forces and are automatically retained in this position in which the pump runs idle. All friction between the vanes 9 and the wall of the bore 6, and pumping noise, are avoided.

When the delivery vacuum drops as a result of consumption, the rod 19 is again moved downwardly by the predominant force of the return spring 23 and again presses each vane 9 against the wall of the bore 6 by means of the abutment surface 29. The mass centre S of the eccentric mass 9' again returns to its initial position across the axis 16 of rotation, the end faces 10 of the vanes 9 again abut against the wall of the bore 6, and the pump commences to operate again.

Claims

1. A rotary positive displacement pump having a rotor which rotates eccentrically in a housing, at least one vane slidable in a slot so as to engage a contact surface and so separate an inlet side from an outlet side, and a device for switching over the or each vane to a position in which it remains out of engagement with the contact surface so that the pump is rendered inoperative, the position of the mass centre of the or each vane being transferable by said device from a positive eccentricity at which the or each vane is retained against its contact surface by the forces due to mass acting thereon, to a negative eccentricity at which the or each vane is held out of engagement with the contact surface by the forces due to mass, and vice-versa.

2. A positive displacement pump as claimed in claim 1 in which said device for displacing the or each vane is operable in dependence upon pump delivery pressure.

3. A positive displacement pump as claimed in claim 1 in which said device for displacing the or each vane operates electro-magnetically responsively to pump delivery pressure.

4. A positive displacement pump as claimed in any of claims 1 to 3 in which the device for displacing the or each vane is operable when a predetermined pump delivery pressure or vacuum reaches a predetermined value.

5. A rotary positive displacement pump as claimed in any preceding claim in which the or each vane is slidable in the rotor and its contact surface is an eccentric bore in the housing.

6. A positive displacement pump as claimed in claim 5 having vanes arranged in at least one overlapping pair in a corresponding slot in the rotor.

7. A rotary positive displacement pump constructed and adapted to operate substantially as herein described with reference to and as illustrated in the drawings.

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